



Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)



VII SEMESTER B.TECH (BIOTECHNOLOGY)

END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: BIOREMEDIATION [BIO 445]

REVISED CREDIT SYSTEM

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer ANY FIVE FULL questions.
- ✤ Missing data may be suitable assumed.

1A.	During pilot studies carried out for the degradation of methyl tert-butyl ether, scientists found that it took more than an year of acclimation period to achieve a removal efficiency greater than 95%, based on average inlet concentrations of 200 ppb. Analyze the reason for the recalcitrant nature of said compound.	2m
1B.	Suggest a possible bioconversion method, wherein humic matter can play a major role in carbon sequestration. Support with an example.	4m
1C.	Although polycyclic aromatic hydrocarbons have usually been found to persist under strict anaerobic conditions, an unusual site was found in New South Wales Bay in which naphthalene and phenanthrene were oxidized to carbon dioxide. Propose a mechanism, how this could have been possible.	4m
2A.	Production of hydrogen sulphide in paper mills and tanneries is an environmental problem. The related sewage distribution systems get corroded rapidly. Formulate a simple cost-effective strategy to alleviate this problem.	2m
2B.	From a PAH-contaminated site, a soil core was extricated from a depth of 4m. The core has a bulk volume of 100 mL, an air volume of 30 cm ³ , a wet mass of 145 g and a dry mass of 125 g. Calculate the total porosity and the bulk density.	3m
2C.	Examine in detail, the roles played by iron and sulphur oxidizers during the bioleaching of chalcocite.	5m
3A.	Though a few standard models have been formulated for studying the kinetics of substrate biodegradation, examine what factors must be considered before implementing a model in any specific bioremediation strategy.	3m
3B.	In 2011, Penn State University revealed that many water wells in the Marcellus region of Pennsylvania were found to have more than detectable	3m

	methane levels, in the range of 28-30 mg/L. The solubility of methane in water is 23 mg/L at 1 atm. Why is this situation dangerous? Devise a strategy to ward off excessive methane build-up.	
3C.	At a site near an ore-processing facility, natural vegetation is lacking due to high metal concentrations in the sub-surface. Suggest any two schemes either to lessen the metal load in the soil or to restore green cover in the area.	4m
4A.	Four hours after inoculation, the bacterial cell numbers in a batch reactor measure 34000 /L . It becomes $5.2 \times 10^6 \text{ /L}$ at 24 h. Assuming a negligible lag phase, determine (a) the specific growth rate (b) the cell number at the time of inoculation.	5m
4B.	A strategy for the cleanup of crude oil from a burst pipeline near Minnesota was undertaken in 1979. The equivalent of 8,000 barrels of oil was removed directly by pumping it out from the aquifer, in a span of 15 days, after which there was negligible recovery. The pipeline was also fixed. Two months later, an additional 2,500 barrels was estimated to be still present in the same the subsurface aquifer. Highlight the reason for the recurrence of this phenomenon. Design a bioremediation strategy to ensure complete removal of any residual crude oil.	5m
5A.	Which of the compounds - pyrene, flourene and chrysene - do you think is the easiest to degrade? Justify your answer.	2m
5B.	What would be the free energy change when succinate is completely metabolized by aerobic microbes? Compare it with the case when glucose is used as the energy source. Present the half-reactions and the combined balanced reaction, for both the cases. It is given that the RP values for the redox pairs $CO_2/C_4H_6O_4$, $CO_2/C_6H_{12}O_6$ and O_2/H_2O are (-) 0.27 V, (-) 0.43 V and (+) 0.82 V, respectively. Comparing the two values of free energy, what is your conclusion?	8m
6A.	 Appointed as the new remediation consultant at a IOC petrol bunk, situated at the heart of Mumbai, what steps would you take (i) for the preventive maintenance against major petrol spillage. (ii) as the post-operative steps, in case the UST underneath develops a major crack and lets around 10000 L of petrol to seep through. You detect the crack and leak, after 15 days. 	5m
6B.	Land treatment has been chosen as the bioremediation process to treat soil from an abandoned wood-treating facility contaminated with PAHs. The volume of soil to be excavated for treatment is estimated at 15000 m ³ . A 17650 m ² land treatment unit has been constructed for this purpose. If the soil is fully devoid of clayey particles, estimate the number of lifts that should be applied, and the appropriate soil depth for each lift in centimeters.	5m